SINGER
INSTRUMENTATION

MAINTENANCE MANUAL

for

FREQUENCY INDICATING MODULES

MODELS FIM–1 AND FIM–3

(For use with Model FM-10C Mainframe)

MANUAL NO. 1-500783-294

(For Use with Serial Numbers 101 and Above)

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This manual refers directly to Model FIM-1 serial numbers suffixed with 04274 and above and Model FIM-3 serial numbers prefixed with 401 and above.

Appendix A, Model FIM-1 Backdating Information adapts this manual to serial numbers 101 thru serial numbers suffixed with 04273.

Appendix B, Model FIM-3 Backdating Information adapts this manual to serial numbers 101 thru serial numbers prefixed with 400.

For operating instructions refer to Model FM-10C Operator's Manual No. 1-500783-258 (Rev B) or later.

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The Singer Company, Los Angeles Operation • 5340 Alla Road, Los Angeles, Ca. 90066

WARRANTY

THE SINGER COMPANY, LOS ANGELES OPERATION, (SELLER) warrants each new instrument to be free from defects in material and workmanship, effective after delivery to the original purchaser as follows:

TCXO Oscillator	2 Years
Electrical and Electronic Measuring Instruments	1 Year

Repair or replacement (at our option) without charge (F.O B. factory) will be effected when our examination satisfactorily indicates that defects are due to workmanship or materials. Electron tubes, semiconductors, batteries, fuses, lamps, thermoelements, and RatioTran potentiometers are excluded from warranty coverage. Warranty returns must first be authorized by the factory.

If the instrument or any portion thereof, has been abused, misused, damaged by accident or negligence, or if any serial number or seal has been removed or altered, the warranty is void.

This warranty is in lieu of all other warranties, express or implied INCLUDING THE IMPLIED WARRANTY OF MERCHANTABILITY, or fitness for a particular purpose. In no event shall the SELLER be liable for INCIDENTAL OR CONSEQUENTIAL damages. The SELLER neither assumes, nor authorizes any person to assume for it, any other liability in connection with sales of instruments manufactured by SELLER.

With respect to repairs, the foregoing warranty shall apply for a period of ninety days to the repaired portion.

THE SINGER COMPANY, LOS ANGELES OPERATION
5340 Alla Road, Los Angeles, California 90066

REPAIR AND MAINTENANCE

Instruments should be returned only on prior authorization from the Singer Representative or the factory. You will be advised of detailed shipping instructions at that time. Return the instrument to the factory Prepaid. Validity of warranty will be determined by the factory.

Chargeable repairs: If requested, an estimate of charges will be made prior to repairs. Please provide us with the following information in order to expedite the processing of your instrument:

1. Model or Type
2. Serial Number
3. Description of trouble(1)
4. Approximate date instrument was placed in operation.
5. Approximate number of hours in use.
6. Has maintenance action been previously requested.
7. Other comments.

(1) Include data on symptoms, measurements taken, suspected location of trouble, maintenance action taken and any other relevant data.

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Section I
THEORY OF OPERATION

1.1 INTRODUCTION

This section consists of the circuit description of the Model FIM-1 and the Model FIM-3 plug-in modules. The information is presented to assist the user in the troubleshooting and maintenance of the instruments. Refer to the Detailed Block Diagrams, Figure 1-1 and 1-2 and the Schematic Diagrams, Figures 4-1 and 4-2.

1.2 GENERAL

The plug-in module derives its power supply and IF signal inputs via the rear connector, P1. The instrument is energized whenever the Mainframe is operating. A single printed circuit board assembly contains the six major sections of the plug-in module: operate lamp circuitry, beat lamp circuitry, meter circuitry, calibrate circuitry, +5 V dc power supply circuitry, and squelch circuitry (Model FIM-3 only).

1.3 DETAILED THEORY

1.3.1 Operate Lamp Circuitry

4.2 MHz from the Mainframe is applied to amplifier, A1Q2, via connector, P1-12. This frequency is divided by two by A1U1, (a binary), producing 2.1 MHz which is applied to the LO port of mixer, A1U5A. The 2 MHz IF frequency from the Model RFM module is applied to the 2 MHz bandpass filter (adjusted by A1L1), via P1-16 to the 2.2 MHz trap (adjusted by A1L4). The output of the 2.2 MHz trap is applied through the 2 MHz buffer, A1Q1, to the signal port of mixer, A1U5A, to produce a difference frequency of 100 kHz. The 2.2 MHz trap prevents the image frequency (2.2 MHz) from mixing with the 2.1 MHz at the LO port of the mixer and producing an intermediate frequency of 100 kHz.

The output of mixer, A1U5A, is amplified by 100 kHz IF amplifier, A1U5B, and is applied to 100 kHz IF amplifier, A1U5C, when RANGE switch, S1, is in the 1.5 kHz, 5 kHz or 15 kHz position.

Level detector, A1U6A, A1C22, is adjusted by variable resistor, A1R31, to fire operate lamp schmidt trigger, A1U6B, C, when the 2 MHz IF input level is exactly 2.5 mV rms. This triggers operate lamp switch, A1U6D, and lights the OPERATE lamp, DS1.

1.3.2 Beat Lamp Circuitry

100 kHz from the Mainframe is applied to the LO port of mixer, A1U7A, via connector P1-14. This mixes with the 100 kHz at the output of the 100 kHz amplifier, A1U5C, and the difference frequency is amplified by beat amplifiers, A1U7B, C and D, and drives beat lamp switch, A1Q3, which in turn flashes the beat lamp, DS2, at the beat rate. The beat note is also applied to the Mainframe via connector, P1-1. Audio squelch diode, A1CR1, enables the beat circuitry to function whenever the OPERATE lamp, DS1, is lit.

1.3.3 Meter Circuitry

The 100 kHz from 100 kHz amplifier, A1U5C, is converted into a square wave by limiter, A1U5D, and is applied to one-shot multivibrator, A1U3, which operates as a pulse-counting discriminator. The two complementary outputs are amplified by the meter amplifier, A1U4A thru A1U4D, and applied to both plates of capacitor A1C9. If the intermediate frequency becomes higher, capacitor, A1C9, will become charged more positive on the positive plate than the negative plate and the meter, M1, which is effectively connected across A1C9, will indicate a positive difference frequency. If the intermediate frequency becomes lower, the opposite procedure will occur. Calibration of the three ranges is accomplished by variable resistors, A1R18, A1R21 and A1R23. When the schmidt trigger fires and the OPERATE lamp is lit, meter enable switches, A1U4E and A1U6E, allow the meter amplifier, A1U4A thru A1U4D, to operate.

1.3.4 Calibrate Circuitry

100 kHz from the Mainframe is applied to the discriminator, A1U3, via P1-14 when the RANGE switch is in the ZERO position. With the ZERO control, R1, at mid-position, variable resistor, A1R8, is adjusted for zero on the meter.

1.3.5 Squelch Circuitry (Model FIM-3 only)

Operate lamp switch, A1U6D, also operates squelch diode switch, A1CR2. When the OPERATE lamp, DS1, is lit and the SQUELCH switch, S2, is in the ON position, diode switch, A1CR2 is reverse-biased and the diode switch, CR4, in the Mainframe is forward-biased, allowing the recovered audio from the right-hand module to reach the VOLUME control in the Mainframe and eventually reach the speaker in the Mainframe.

If the OPERATE lamp is not lit, diode switch, A1CR2, is forward-biased and the diode switch, CR4, in the Mainframe is reverse-biased, and the audio circuit is open circuited.

With the SQUELCH switch in the OFF position, the diode switch, CR4, in the Mainframe is always forward-biased and the audio circuit is completed.

1.3.6 Power Supply Circuitry

+9 V dc is applied to voltage regulator, A1U2, via P1-9. Variable resistor, A1R4, is adjusted to produce +5 V dc which is required for some of the integrated circuits employed in the instrument.

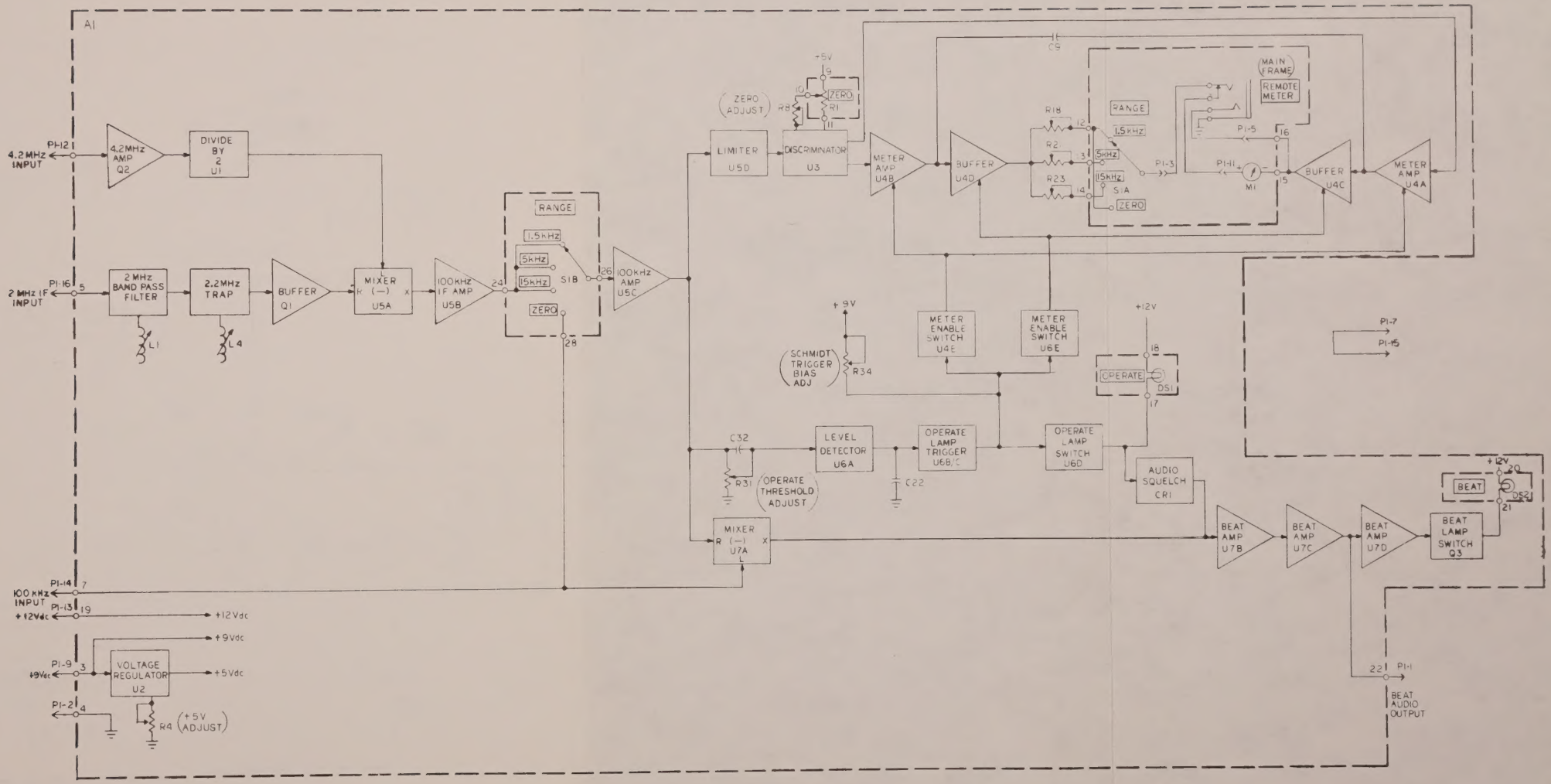


Figure 1-1. Detailed Block Diagram
Model FIM-1
Dwg. No. 4-501481-001

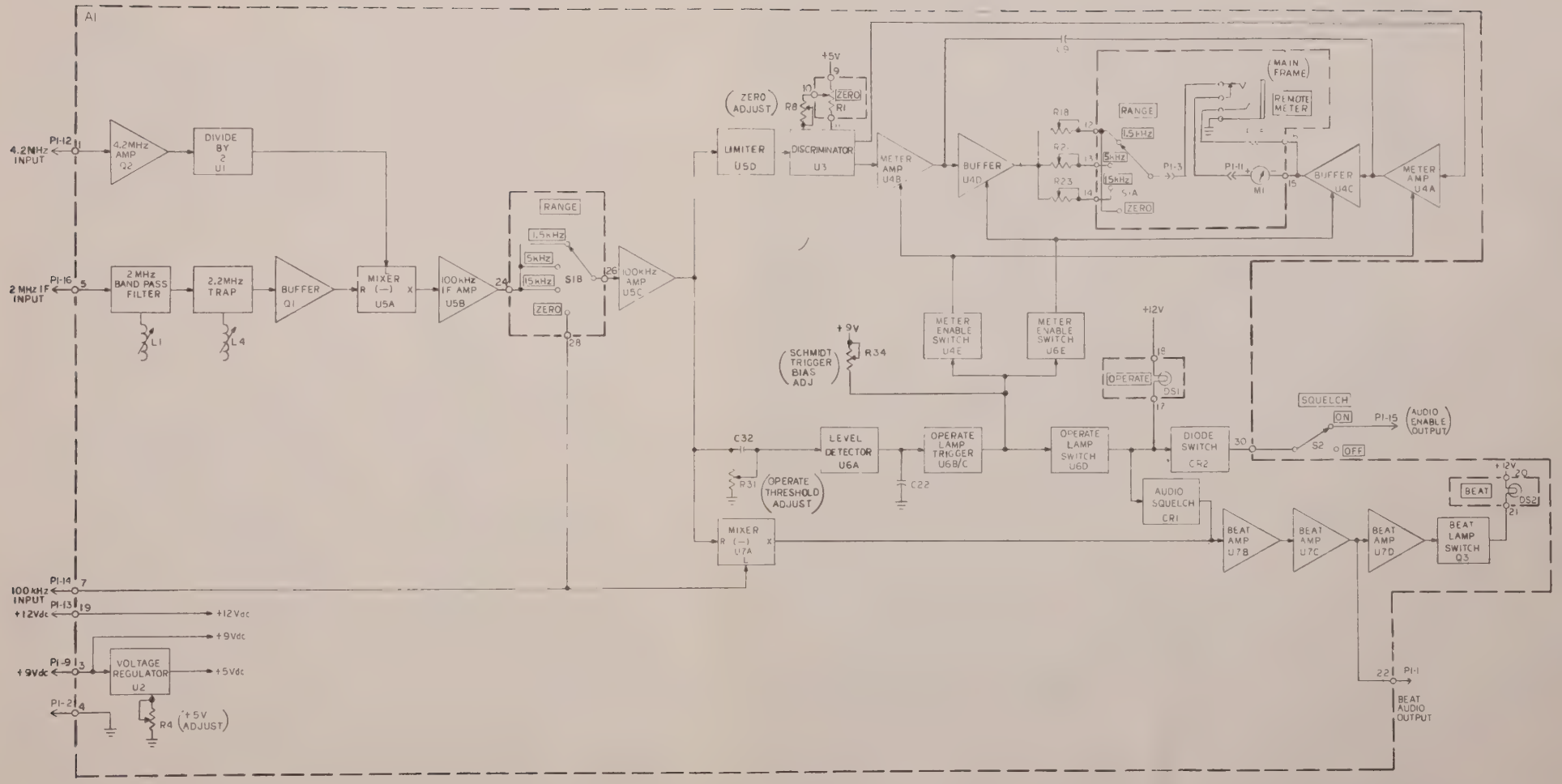


Figure 1-2. Detailed Block Diagram
Model FIM-3
Dwg. No. 4-501482-001

Section II
MAINTENANCE

2.1 INTRODUCTION

This section contains information for the maintenance of the Models FIM-1 and FIM-3. Included are Minimum Performance Procedures, Alignment and Adjustment Procedures and Fault Isolation Procedures.

All ac and dc voltages displayed without tolerances on the Schematic Diagrams in Section IV are typical. The dc voltages may vary widely (+100%, −50%) and the ac voltages may vary widely (±6 dB) due to component tolerances and beta ranges of the transistors. This does not imply that instruments in which measured voltages are at the tolerance extremes will not perform to the specifications, since the instrument has been designed to allow for these tolerances.

2.2 PRELIMINARY INFORMATION

2.2.1 Alignment Interval

To ensure instrument accuracy check the Model FIM-1 or FIM-3 performance using the Minimum Performance Procedures every 1000 hours of operation, or every six months if used occasionally.

2.2.2 Singer Customer Service

Both Factory and Field Centers provide instrument service and repair. Contact your local Singer representative for additional information.

2.2.3 Minimum Performance Procedures Defined

The performance of the instrument can be checked without removing the covers or performing internal adjustments by the use of the Minimum Performance Procedures (Refer to Paragraph 2.4). These procedures do not test every detail of the alignment of the instrument but do check the overall performance for accuracy and correct operation within allowable tolerances.

2.2.4 Alignment and Adjustment Procedures Defined

The completion of each step of the Alignment and Adjustment Procedure, (refer to Paragraph 2.5) ensures that the instrument meets the electrical specifications provided in Section II of the Operator's Manual. For best overall instrument performance when performing a complete Alignment and Adjustment Procedure, adjust each trimmer as close as possible to the exact figure, even though the Minimum Performance Procedures indicate that the operation is within the allowable tolerance.

2.3 TEST EQUIPMENT REQUIRED

The test equipment required for the Minimum Performance Alignment and Adjustment Procedures and Fault Isolation Procedures is listed in Table 2-1. Minimum specifications are provided to aid in the selection of equivalent types.

2.4 MINIMUM PERFORMANCE PROCEDURES

NOTE

The equipment should be checked at a temperature of 25°C±5°C for best overall performance.

2.4.1 Power Requirements

All power required by the module is supplied by the Mainframe.

2.4.2 Evaluation of Calibration

a. Install the module part way into the center compartment of the Mainframe. Verify that the meter indicates zero. Adjust the mechanical zero if necessary.

b. Install the module in Mainframe and set the module RANGE switch to ZERO position. Adjust meter to zero with the ZERO control.

c. Set Mainframe MODE switch to TONE GEN, Frequency switches to 000.0000 MHz, 0–100 Hz control to OUT and VOLUME control to approximately mid-range.

d. Set the module RANGE switch to 1.5 position. Vary the Mainframe 100 Hz and 1 kHz switches in 100 Hz steps up to 1.5 kHz. The module meter should deflect to the left in 100 Hz increments ±75 Hz and an audio tone corresponding to the frequency should be heard from the speaker.

e. Set the 100 Hz and 1 kHz switches to zero. Set the module RANGE switch to 5. Vary the 1 kHz Frequency switch up to 5 kHz. The module meter should deflect to the left in 1 kHz increments ±350 Hz and an audio tone corresponding to the frequency should be heard from the speaker.

f. Set the 1 kHz switch to zero. Set the module RANGE switch to 15. Vary the 1 kHz and 10 kHz Frequency switches in 1 kHz steps up to 15 kHz. The module meter should deflect to the left in 1 kHz increments ±850 Hz and an audio tone corresponding to the frequency should be heard from the speaker (up to the tester's hearing limit).

2.4.3 Evaluation of Sensitivity

a. Set the Mainframe MODE switch to MEAS, MEASURE MODE AUDIO OUTPUT switch to IN-BEAT NOTE, GENERATOR MODULATION switch to OUT-OFF, Frequency switches to 150 MHz and VOLUME control to fully cw.

b. Set the module MEASURE MODE BANDWIDTH switch to OUT-WIDE and set the SENSITIVITY controls for maximum sensitivity.

c. Connect the ac voltmeter to the rear panel ACC receptacle, Pin A, to monitor the 2 MHz IF output level.

d. Connect the signal generator to the RFM module MEASURE INPUT receptacle. Set the frequency generator to 151 MHz and vary the level to just above that required to light the OPERATE lamp.

e. Vary the signal generator frequency slightly to obtain a zero beat indication.

Table 2-1. Test Equipment Requirements

Instrument	Minimum Specifications	Recommended		Use*
		Manufacturer	Model	
Signal generator	Frequency range: 2 MHz to 150 MHz Output level: 2.5 mV to 8.2 mV rms Output impedance: 50 ohms	Singer	FM-2748	M,A
Oscilloscope with 10X probe	Frequency response: 4.2 MHz Vertical sensitivity: 5 mV/div	Tektronix	531 with plug-in 53/54B	A
Ac voltmeter	Frequency response: 50 Hz to 2 MHz Input level: 2 mV to 400 mV rms Input resistance: 1 megohm minimum Input capacitance: 35 pF maximum	Hewlett-Packard	400E	M,A
Dc digital voltmeter	Input level: +5 V dc Accuracy: ±0.1%	Hewlett-Packard	3440A	A
4.2 MHz signal generator	Frequency range: 4.2 MHz Output level: +1 dBm Output impedance: 50 ohms	Singer	FM-2748	A
100 kHz signal generator	Frequency range: 100 kHz Output level: 1.4 V rms Output impedance: 600 ohms	Hewlett-Packard	652A	A
Power supply	Output level: 12 V dc ±10% at 100 mA	Hewlett-Packard	721A	A
Power supply	Output level: 9 V dc at 250 mA	Hewlett-Packard	721A	A
Mainframe/Model RFM module	Required for testing module	Singer mainframe with RFM module	FM-10C	M
Resistors	5 kilohm, ±5%, 1/4 watt; 13 ohm, ±5%, 1/4 watt	Not applicable		A
Connector	16 pin	Amphenol	26-190-16	A

*A=Alignment and Adjustment and Fault Isoaltion

M=Minimum Performance

f. Vary the signal generator level to the lowest value that will just light the OPERATE lamp. The ac voltmeter should indicate 2.7 mV ±0.27 mV.

2.4.4 Evaluation of Squelch (Model FIM-3 only)

a. Vary the signal generator output level until the OPERATE lamp just lights. There should be no background noise from the speaker.

b. There should be no background noise from the speaker in either position of the SQUELCH switch.

c. Decrease the signal generator level until the OPERATE lamp extinguishes.

d. Background noise should be audible only in the OFF position of the SQUELCH switch.

2.5 ALIGNMENT AND ADJUSTMENT

NOTE

The Alignment and Adjustment Procedure is performed with the module disconnected from the Mainframe so that no problem in the Mainframe will affect the alignment of the module. Remove the four screws from the back of the module and slide the cover off.

NOTE

The equipment should be aligned at a temperature of 25°C ±5°C for best overall performance.

2.5.1 Test Connector Wiring

a. See Figure 2-1 for schematic diagram of test connector wiring.

2.5.2 +5 V Power Supply Adjustment (See Figure 2-2)

a. Plug the test connector onto the connector on the back of the module.

b. Connect the digital voltmeter positive lead to positive side of A1C4 and negative lead to chassis ground.

c. Adjust A1R4 for +5 V dc on the digital voltmeter.

d. Disconnect the digital volmeter.

2.5.3 2 MHz IF Input Filter Alignment

a. Connect the ac voltmeter to the signal generator output at the input side of the 13 ohm resistor at Terminal 16 of the test connector (See Figure 2-1).

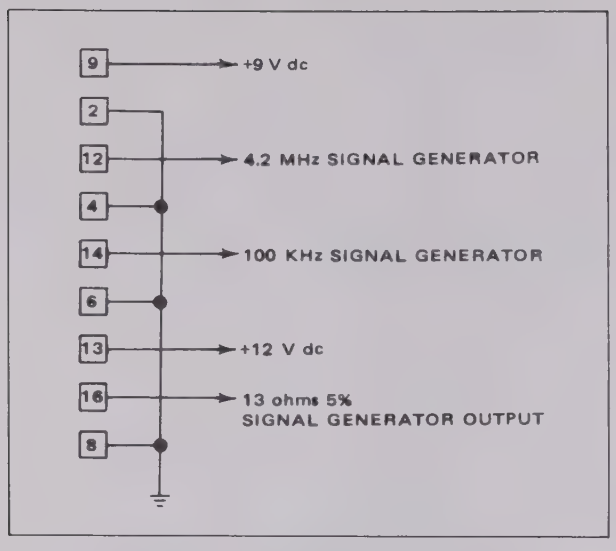


Figure 2-1. Schematic Diagram, Test Connector Wiring

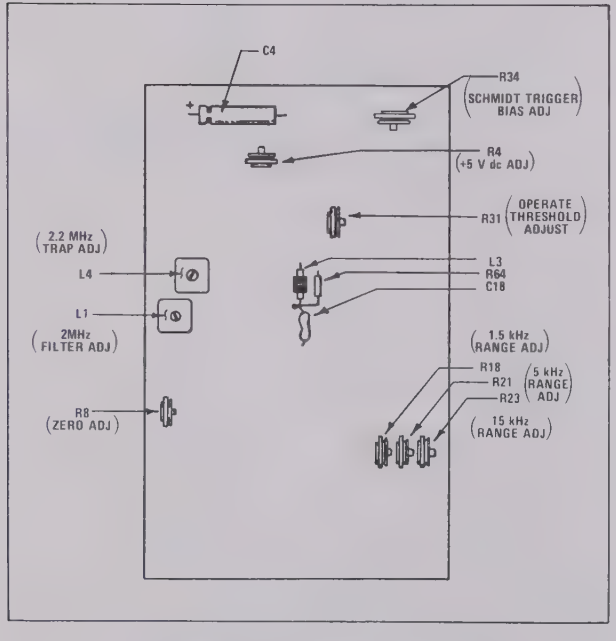


Figure 2-2. Trimmer Locations, Circuit Board Assembly, A1

b. Set the signal generator frequency to 2.2 MHz and its attenuator to indicate 2.7 mV on the ac voltmeter.

c. Connect the oscilloscope using 10X probe to the junction of A1R64 and A1C18.

d. Observe the oscilloscope and adjust A1L4 for minimum 100 kHz output level.

e. Set the signal generator frequency to 2 MHz.

f. Observe the oscilloscope and adjust A1L1 for maximum 100 kHz signal output level.

g. Repeat Steps a. thru f.

h. Remove the oscilloscope from the junction of A1R64 and A1C18.

2.5.4 Operate Lamp Adjustments

a. Set A1R34 to mid-position.

b. Adjust A1R31 so that the OPERATE lamp just lights.

c. Decrease the input level by 1 dB.

d. Adjust A1R34 so that the OPERATE lamp just extinguishes.

2.5.5 Meter Calibration, 1.5 kHz Range

a. Set the mechanical zero on the module meter.

b. Connect a jumper lead between pin 3 and pin 11 on the test connector.

c. Set ZERO control to mid-range.

d. Set the RANGE switch to the ZERO position.

e. Adjust A1R8 for zero on the module meter.

f. Set the signal generator frequency to 2.0015 MHz.

g. Set the signal generator attenuator to produce 3.5 mV on the ac voltmeter.

h. Set the RANGE switch to the 1.5 kHz position.

k. Observe the module meter and adjust A1R18 for +1.5 kHz.

l. Observe BEAT lamp. It should be lit.

m. Set the signal generator frequency to 1.9985 MHz. The module meter should indicate −1.5 kHz.

2.5.6 Meter Calibration, 5 kHz Range

a. Set the RANGE switch to the 5 kHz position.

b. Set the signal generator frequency to 2.005 MHz.

c. Adjust the A1R21 on the module for +5 kHz on the module meter.

d. Set the signal generator frequency to 1.995 MHz. The module meter should indicate −5 kHz.

2.5.7 Meter Calibration, 15 kHz Range

a Set the RANGE switch to the 15 kHz position.

b. Set the signal generator frequency to 2.015 MHz.

c. Adjust A1R23 for +15 kHz on the module meter.

d. Set the signal generator frequency to 1.985 MHz. The module meter should indicate −15 kHz.

2.6 FAULT ISOLATION PROCEDURES

Fault Isolation Procedures are presented to provide a guide in servicing the module. The procedures follow the sequence of the Minimum Performance Procedures, Paragraph 2.4 with each subsection keyed to the step in Paragraph 2.4 that first indicates a fault. When a fault is noted during module operation, proceed as follows:

a. Perform Minimum Performance Procedures in Paragraph 2.4.

b. Start Fault Isolation Procedures at the point where minimum performance cannot be satisfied.

c. When the fault is isolated to a function, such as the discriminator, refer to the alignment

procedures for that function in Paragraph 2.5 and check alignment of that function before proceeding with fault isolation.

d. After a fault is repaired, complete the Minimum Performance Procedure to determine if further alignment is necessary.

2.6.1 Meter Does Not Indicate Zero (2.4.1-a.)

a. Adjust the mechanical zero on the meter for zero indication on the meter.

2.6.2 Zero Control Defective (2.4.1-b.)

a. Check for 100 kHz at the output of limiter, A1U5D.

b. Check both outputs of discriminator, A1U3.

c. Check meter amplifier, A1U4A thru A1U4D.

d. Check RANGE switch, S1A, and associated wiring.

e. Check REMOTE METER receptacle on the Mainframe and associated wiring.

f. Check that meter enable switches, A1U4E and A1U6E, are operating.

g. Check meter, M1.

2.6.3 Meter Does Not Deflect in 100 Hz Increments (2.4.1-d.)

a. Perform Paragraph 2.6.2.

2.6.4 Audio Tone Defective (2.4.1-d.)

a. Check for jumper between A1-30 and A1-31.

b. Check for audio at mixer, A1U7A, output.

c. Check for audio at A1-22.

d. Check audio squelch diode, A1CR1.

2.6.5 Meter Does Not Deflect in 1 kHz Increments in 5 kHz Range (2.4.1-e.)

a. Check A1R21.

b. Check RANGE switch, S1.

2.6.6 Meter Does Not Deflect in 1 kHz Increments in 15 kHz Range (2.4.1-f.)

a. Check A1R23.

b. Check RANGE switch, S1.

2.6.7 Sensitivity Not Within Tolerance (2.4.3-f.)

a. Check alignment of operate threshold adjustment A1R31 as in Step 2.5.4-a.

b. Check level detector, A1U6A, operate lamp trigger, A1U6B, C, operate lamp switch, A1U6D, diode switch, A1CR2, and SQUELCH switch, S2.

2.6.8 Squelch Inoperative (2.4.4-d.)

a. Check diode switch A1CR2.

b. Check SQUELCH switch, S2.

c. If Steps 2.6.7-a. and b. operate properly, trouble is in Mainframe. Check Mainframe as in Mainframe Maintenance Manual.

Section III
REPLACEABLE PARTS

3.1 INTRODUCTION

This section contains information for ordering replacement parts. Tables 3-1 and 3-2 list the parts according to their functional groupings. Parts are listed in alpha-numerical order of their reference designators and indicate the description, the Singer part number, typical manufacturer of the part in a five-digit code, and the manufacturer's part number. Table 3-3 lists the typical manufacturers in numerical code number order.

Table 3-1. Parts List for Main Assemblies and Chassis

Ref. Desig.	Description	Singer Part No.	Mfr. Code No.	Mfr. Part No.
A1	Assembly, Circuit Board	4-004279-006	88869	
C1	Capacitor, fixed, ceramic, 150 pF, ±10%, 500 V dc	1-900069-017	72982	CK60BX151M
DS1	Light, indicator, green, 10 V, 20 mA	1-925007-002	32539	L10/20
DS2	Light, indicator, amber, 10 V, 20 mA	1-925007-001	32539	L10/20
P1	Connector, plug, rectangular, 16 Pin	1-910071-001	02660	26-159-16
M1	Meter, 100-0-100 uA	1-937011-001	32171	2S-DUA1H1
R1	Resistor, variable, composition, 100 ohm, ±30%, 1/2 W	1-403268-001	71450	5Va45
S1	Switch, rotary, 2 pole, 4 position	1-003214-004	71450	223
S2 (FIM-3 only)	Switch, toggle, SPDT	1-951036-001	09353	7101

Table 3-2. Parts List for Printed Circuit Board Assembly, A1

Ref. Desig.	Description	Singer Part No.	Mfr. Code No.	Mfr. Part No.
C1	Capacitor, fixed, ceramic, 0.001 uF, +100% 0%, 500 V dc	1-900012-002	72982	861Z5U102P
C2	Capacitor, fixed, electrolytic, 200 uF, 10% +75%, 15 V dc	1-900039-002	72699	984-1733
C3	Capacitor, fixed, plastic, 0.1 uF, ±20%, 250 V dc	1-900001-013	73445	C280AE,0.1uF
C4	Capacitor, fixed, electrolytic, 200 uF, 10% +75%, 15 V dc	1-900039-002	72699	984-1733
C5	Capacitor, fixed, electrolytic, 25 uF, 10% +75%, 25 V dc	1-900039-001	72699	984-2203
C6	Capacitor, fixed, mica, 360 pF, ±5%, 500 V dc	1-900003-044	72136	DM15F361J
C7	Capacitor, fixed, plastic, 0.1 uF, ±20%, 250 V dc	1-900001-013	73445	C280AE,0.1uF
C8	Capacitor, fixed, plastic, 0.1 uF, ±20%, 250 V dc	1-900001-013	73445	C280AE,0.1uF
C9	Capacitor, fixed, plastic, 0.1 uF, ±20%, 250 V dc	1-900001-013	73445	C280AE,0.1uF
C10	Capacitor, fixed, electrolytic, 25 uF, 10% +75%, 25 V dc	1-900039-001	72699	984-2203
C11	Capacitor, fixed, electrolytic, 25 uF, 10% +75%, 25 V dc	1-900039-001	72699	984-2203
C12	Capacitor, fixed, mica, 160 pF, ±5%, 500 V dc	1-900003-035	72136	DM15F161J
C13	Capacitor, fixed, mica, 1200 pF, ±5%, 100 V dc	1-900003-057	72136	DM15F122J
C14	Capacitor, fixed, plastic, 0.01 uF, ±20%, 250 V dc	1-900001-001	73445	C280AE,0.01uF
C15	Capacitor, fixed, plastic, 0.1 uF, ±20%, 250 V dc	1-900001-013	73445	C280AE,0.1uF
C16	Capacitor, fixed, mica, 910 pF, ±5%, 100 V dc	1-900003-055	72136	DM15F911J
C17	Capacitor, fixed, mica, 160 pF, ±5%, 500 V dc	1-900003-035	72136	DM15F161J
C18	Capacitor, fixed, mica, 910 pF, ±5%, 100 V dc	1-900003-055	72136	DM15F911J
C19	Capacitor, fixed, mica, 82 pF, ±5%, 500 V dc	1-900003-028	72136	DM15E820J
C20	Capacitor, fixed, mica, 160 pF, ±5%, 500 V dc	1-900003-035	72136	DM15F161J
C21	Capacitor, fixed, electrolytic, 25 uF, 10% +75%, 25 V dc	1-900039-001	72699	984-2203
C22	Capacitor, fixed, electrolytic, 1.0 uF, ±20%, 50 V dc	1-900115-003	12954	D1ROGSA50M
C23	Capacitor, fixed, plastic, 0.022 uF, ±20%, 250 V dc	1-900001-005	73445	C280AE,0.022uF
C24	Capacitor, fixed, ceramic, 0.001 uF, +100% 0%, 500 V dc	1-900012-002	72982	861Z5U102P

Table 3-2. Parts List for Printed Circuit Board Assembly, A1 (Cont.)

Ref. Desig.	Description	Singer Part No.	Mfr. Code No.	Mfr. Part No.
C25	Capacitor, fixed, electrolytic, 25 uF, -10% +75%, 25 V dc	1-900039-001	72699	984-2203
C26	Capacitor, fixed, ceramic, 0.001 uF, +100% 0%, 500 V dc	1-900012-002	72982	861Z5U102P
C27	Capacitor, fixed, ceramic, 0.001 uF, +100% 0%, 500 V dc	1-900012-002	72982	861Z5U102P
C28	Capacitor, fixed, ceramic, 0.001 uF, +100% 0%, 500 V dc	1-900012-002	72982	861Z5U102P
C29	Capacitor, fixed, electrolytic, 25 uF, 10% +75%, 25 V dc	1-900039-001	72699	983-2203
C30	Capacitor, fixed, ceramic, 0.005 uF, +80% 20%, 500 V dc	1-900012-004	72982	801Z5U502Z
C31	Capacitor, fixed, mica, 100 pF, ±5%, 500 V dc	1-900003-030	72136	DM15F101J
C32	Capacitor, fixed, plastic, 0.01 uF, ±20%, 250 V dc	1-900001-001	73445	C280AE,0.01uF
C33	Capacitor, fixed, plastic, 0.01 uF, ±20%, 250 V dc	1-900001-001	73445	C280AE,0.01uF
C34	Not used			
C35 (FIM-3 only)	Capacitor, fixed, electrolytic, 200 uF, -10% +75%, 15 V dc	1-900039-002	72699	984-1733
CR1	Diode, silicon, Vr=75 V, If=10 mA	1-913007-001	03508	1N4148
CR2 (FIM-3 only)	Diode, silicon, Vr=20 V, If=100 mA	1-913074-001	80795	1TT244
L1	Inductor, variable, 30 uH to 60 uH	1-906006-003	88869	
L2	Inductor, fixed, 2.5 uH, ±10%, 50 mA	1-906002-054	76493	70F253A1
L3	Inductor, fixed, 2.5 uH, ±10%, 50 mA	1-906002-054	76493	70F253A1
L4	Inductor, variable, 30 uH to 60 uH	1-906006-003	88869	
Q1	Transistor, silicon, NPN	1-958000-001	04713	2N3904-5
Q2	Transistor, silicon, NPN	1-958000-001	04713	2N3904-5
Q3	Transistor, silicon, NPN	1-958000-001	04713	2N3904-5
R1	Resistor, fixed, composition, 120 kilohm, ±10%, 1/4 W	1-945000-062	01121	CB1241
R2	Resistor, fixed, composition, 1.0 kilohm, ±10%, 1/4 W	1-945000-037	01121	CB1021
R3	Resistor, fixed, composition, 10 ohm, ±10%, 1/4 W	1-945000-013	01121	CB1001
R4	Resistor, variable, composition, 1.0 kilohm, ±30%, 1/4 W	1-945007-004	71450	X201
R5	Resistor, fixed, composition, 1.0 kilohm, ±10%, 1/4 W	1-945000-037	01121	CB1021

Table 3-2. Parts List for Printed Circuit Board Assembly, A1 (Cont.)

Ref. Desig.	Description	Singer Part No.	Mfr. Code No.	Mfr. Part No.
R6	Resistor, fixed, composition, 10 ohm, ±10%, 1/4 W	1-945000-013	01121	CB1001
R7	Resistor, fixed, film, 18.2 kilohm, ±1%, 1/4 W	1-945016-314	72982	RN60D1822F
R8	Resistor, variable, composition, 5 kilohm, ±30%, 1/4 W	1-945007-006	71450	X201
R9	Resistor, fixed, composition, 10 ohm, ±10%, 1/4 W	1-945000-013	01121	CB1001
R10	Resistor, fixed, composition, 4.7 kilohm, ±10%, 1/4 W	1-945000-045	01121	CB4721
R11	Resistor, fixed, composition, 4.7 kilohm, ±10%, 1/4 W	1-945000-045	01121	CB4721
R12	Resistor, fixed, composition, 1.0 kilohm, ±10%, 1/4 W	1-945000-037	01121	CB1021
R13	Resistor, fixed, composition, 1.0 kilohm, ±10%, 1/4 W	1-945000-037	01121	CB1021
R14	Resistor, fixed, composition, 4.7 kilohm, ±10%, 1/4 W	1-945000-045	01121	CB4721
R15	Resistor, fixed, composition, 4.7 kilohm, ±10%, 1/4 W	1-945000-045	01121	CB4721
R16	Resistor, fixed, composition, 56 ohm, ±10%, 1/4 W	1-945000-022	01121	CB5601
R17	Resistor, fixed, composition, 560 ohm, ±10%, 1/4 W	1-945000-034	01121	CB5611
R18	Resistor, variable, composition, 500 ohm, ±30%, 1/4 W	1-945007-003	71450	X201
R19	Resistor, fixed, composition, 2.7 kilohm, ±10%, 1/4 W	1-945000-042	01121	CB2721
R20	Resistor, fixed, composition, 2.2 kilohm, ±10%, 1/4 W	1-945000-041	01121	CB2221
R21	Resistor, variable, composition, 2.5 kilohm, ±30%, 1/4 W	1-945007-005	71450	X201
R22	Resistor, fixed, composition, 8.2 kilohm, ±10%, 1/4 W	1-945000-048	01121	CB8221
R23	Resistor, variable, composition, 5 kilohm, ±30%, 1/4 W	1-945007-006	71450	X201
R24	Resistor, fixed, composition, 2.7 kilohm, ±10%, 1/4 W	1-945000-042	01121	CB2721
R25	Resistor, fixed, composition, 15 kilohm, ±10%, 1/4 W	1-945000-051	01121	CB1531
R26	Resistor, fixed, composition, 4.7 kilohm, ±10%, 1/4 W	10945000-045	01121	CB4721
R27	Resistor, fixed, composition, 4.7 kilohm, ±10%, 1/4 W	1-945000-045	01121	CB4721
R28	Resistor, fixed, composition, 27 kilohm, ±10%, 1/4 W	1-945000-054	01121	CB2731
R29	Resistor, fixed, composition, 15 kilohm, ±10%, 1/4 W	1-945000-051	01121	CB1531

Table 3-2. Parts List for Printed Circuit Board Assembly, A1 (Cont.)

Ref. Desig.	Description	Singer Part No.	Mfr. Code No.	Mfr. Part No.
R30	Resistor, fixed, composition, 100 ohm, ±10%, 1/4 W	1-945000-025	01121	CB1011
R31	Resistor, variable, composition, 5 kilohm, ±30%, 1/4 W	1-945007-006	71450	X201
R32	Resistor, fixed, composition, 2.7 kilohm, ±10%, 1/4 W	1-945000-042	01121	CB2721
R33	Resistor, fixed, composition, 10 ohm, ±10%, 1/4 W	1-945000-013	01121	CB1001
R34	Resistor, variable, composition, 2.5 kilohm, ±30%, 1/4 W	1-945007-005	71450	X201
R35	Resistor, fixed, composition, 680 ohm, ±10%, 1/4 W	1-945000-035	01121	CB6811
R36	Resistor, fixed, composition, 1.0 kilohm, ±10%, 1/4 W	1-945000-037	01121	CB1021
R37	Resistor, fixed, composition, 470 ohm, ±10%, 1/4 W	1-945000-033	01121	CB4711
R38	Resistor, fixed, composition, 3.3 kilohm, ±10%, 1/4 W	1-945000-043	01121	CB3321
R39	Resistor, fixed, composition, 68 ohm, ±10%, 1/4 W	1-945000-023	01121	CB6801
R40	Resistor, fixed, composition, 4.7 kilohm, ±10%, 1/4 W	1-945000-045	01121	CB4721
R41	Resistor, fixed, composition, 2.2 kilohm, ±10%, 1/4 W	1-945000-041	01121	CB2221
R42	Resistor, fixed, composition, 10 kilohm, ±10%, 1/4 W	1-945000-049	01121	CB1031
R43	Resistor, fixed, composition, 10 kilohm, ±10%, 1/4 W	1-945000-049	01121	CB1031
R44	Resistor, fixed, composition, 5.6 kilohm, ±10%, 1/4 W	1-945000-046	01121	CB5621
R45	Resistor, fixed, composition, 2.2 kilohm, ±10%, 1/4 W	1-945000-041	01121	CB2221
R46	Resistor, fixed, composition, 10 ohm, ±10%, 1/4 W	1-945000-013	01121	CB1001
R47	Resistor, fixed, composition, 3.3 kilohm, ±10%, 1/4 W	1-945000-043	01121	CB3321
R48	Resistor, fixed, composition, 5.6 kilohm, ±10%, 1/4 W	1-945000-046	01121	CB5621
R49	Resistor, fixed, composition, 5.6 kilohm, ±10%, 1/4 W	1-945000-046	01121	CB5621
R50	Resistor, fixed, composition, 5.6 kilohm, ±10%, 1/4 W	1-945000-046	01121	CB5621
R51	Resistor, fixed, composition, 3.9 kilohm, ±10%, 1/4 W	1-945000-044	01121	CB3921
R52	Resistor, fixed, composition, 10 kilohm, ±10%, 1/4 W	1-945000-049	01121	CB1031

Table 3-2. Parts List for Printed Circuit Board Assembly, A1 (Cont.)

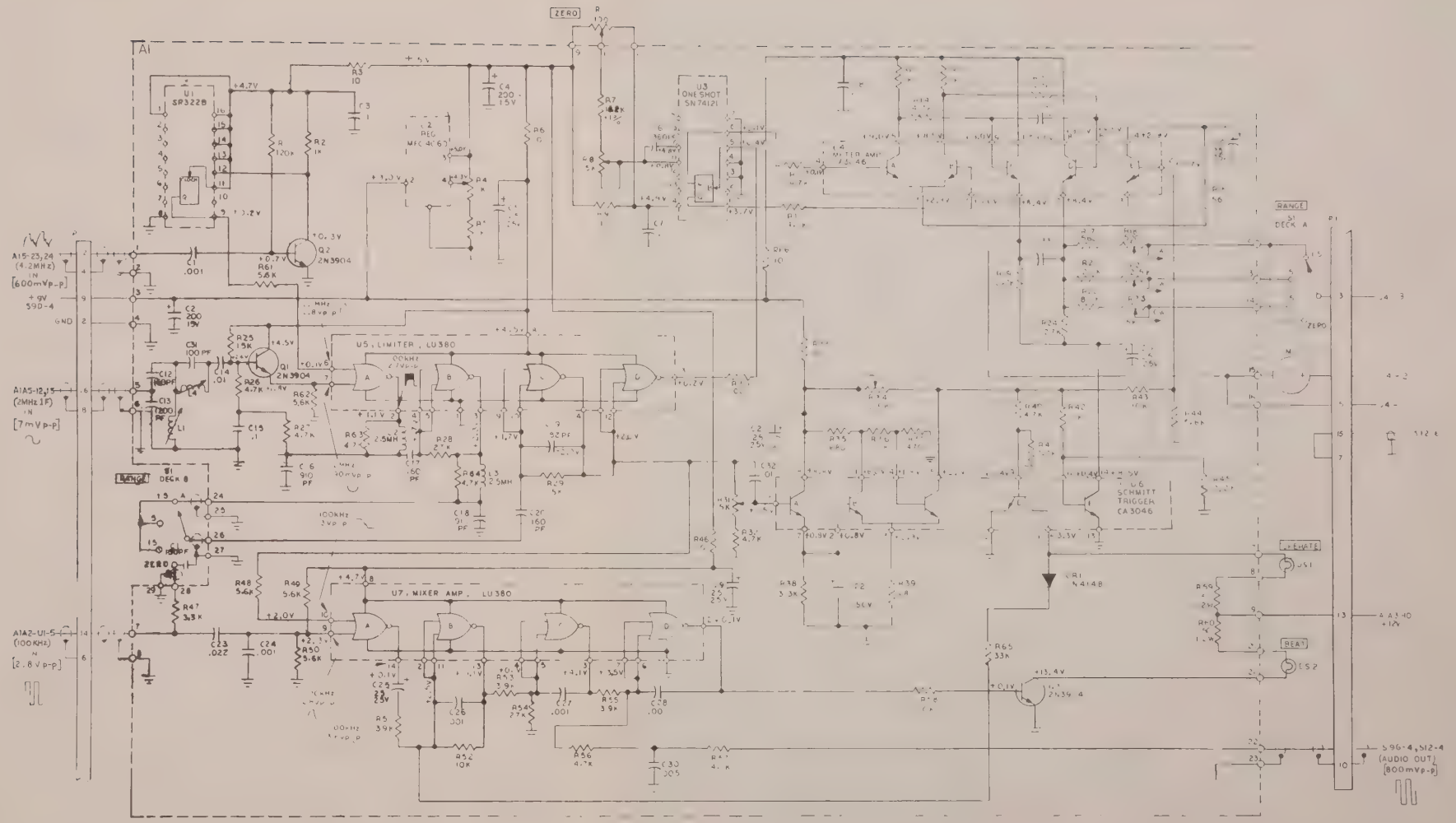
Ref. Desig.	Description	Singer Part No.	Mfr. Code No.	Mfr. Part No.
R53	Resistor, fixed, composition, 3.9 kilohm, ±10%, 1/4 W	1-945000-044	01121	CB3921
R54	Resistor, fixed, composition, 27 kilohm, ±10%, 1/4 W	1-945000-054	01121	CB2731
R55	Resistor, fixed, composition, 3.9 kilohm, ±10%, 1/4 W	1-945000-044	01121	CB3921
R56	Resistor, fixed, composition, 4.7 kilohm, ±10%, 1/4 W	1-945000-045	01121	CB4721
R57	Resistor, fixed, composition, 4.7 kilohm, ±10%, 1/4 W	1-945000-045	01121	CB4721
R58	Resistor, fixed, composition, 10 kilohm, ±10%, 1/4 W	1-945000-049	01121	CB1031
R59	Resistor, fixed, composition, 150 ohm, ±10%, 1/2 W	1-945001-027	01121	EB1511
R60	Resistor, fixed, composition, 150 ohm, ±10%, 1/2 W	1-945001-027	01121	EB1511
R61	Resistor, fixed, composition, 5.6 kilohm, ±10%, 1/4 W	1-945000-046	01121	CB5621
R62	Resistor, fixed, composition, 5.6 kilohm, ±10%, 1/4 W	1-945000-046	01121	CB5621
R63	Resistor, fixed, composition, 4.7 kilohm, ±10%, 1/4 W	1-945000-045	01121	CB4721
R64	Resistor, fixed, composition, 4.7 kilohm,±10%, 1/4 W	1-945000-045	01121	CB4721
R65	Resistor, fixed, composition, 33 kilohm, ±10%, 1/4 W	1-945000-055	01121	CB3331
R66	Resistor, fixed, composition, 10 ohm, ±10%, 1/4 W	1-945000-013	01121	CB1001
R67	Not used			
R68 (F1M-3 only)	Resistor, fixed, composition, 330 ohm, ±10%, 1/4 W	1-945000-031	01121	CB3311
U1	Integrated circuit, dual JK binary	1-926021-002	17856	SP322B
U2	Integrated circuit, voltage regulator	1-926045-001	04713	MFC4060
U3	Integrated circuit, monostable multivibrator	1-926007-023	01295	SN74121
U4	Integrated circuit, general purpose transistor array	1-926044-001	02735	CA3046
U5	Integrated circuit, quad 2-input NOR gate	1-926018-001	17856	LU380A
U6	Integrated circuit, general purpose transistor array	1-926044-001	02735	CA3046
U7	Integrated circuit, quad 2-input NOR gate	1-926018-001	17856	LU380A

Table 3-3. Code List of Manufacturers

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbook H4-2.

Code No.	Manufacturer	Address
01121	Allen-Bradley Co.	Milwaukee, Wis.
01295	Texas Instruments, Inc., Transistors Products Div.	Dallas, Texas
02660	Amphenol-Bunker Ramo Corp., Connector Div.	Broadview, Ill.
02735	RCA Semiconductor and Materials Div.	Sommerville, N.J.
03508	G.E. Semiconductor Prod. Div.	Syracuse, N.Y.
04713	Motorola Inc.	Phoenix, Ariz.
09353	C and K Components Inc.	Watertown, Mass.
12954	Dickson Electronics Corp.	Scottsdale, Ariz.
17856	Siliconix, Inc.	Santa Clara, Calif.
32171	Modutec	Norwalk, Conn.
32539	Mura Corp.	Great Neck, N.Y.
71450	CTS Corp.	Elkhart, Ind.
71468	ITT Cannon	Santa Ana, Calif.
71590	Centralab Electronics	Milwaukee, Wis.
71785	Cinch Mfg., Div. of United Carr	Chicago, Ill.
72136	Electro Motive Mfg. Co.	Willimantic, Conn.
72699	General Instrument Corp.	Newark, N.J.
72982	Erie Technological Products Inc.	Erie, Pa.
73445	Amperex Electronics Co.	Hicksville, N.Y.
76493	Miller, J.W.	Compton, Calif.
80795	ITT Semiconductors	New York, N.Y.
88869	Singer Instrumentation	Los Angeles, Calif.

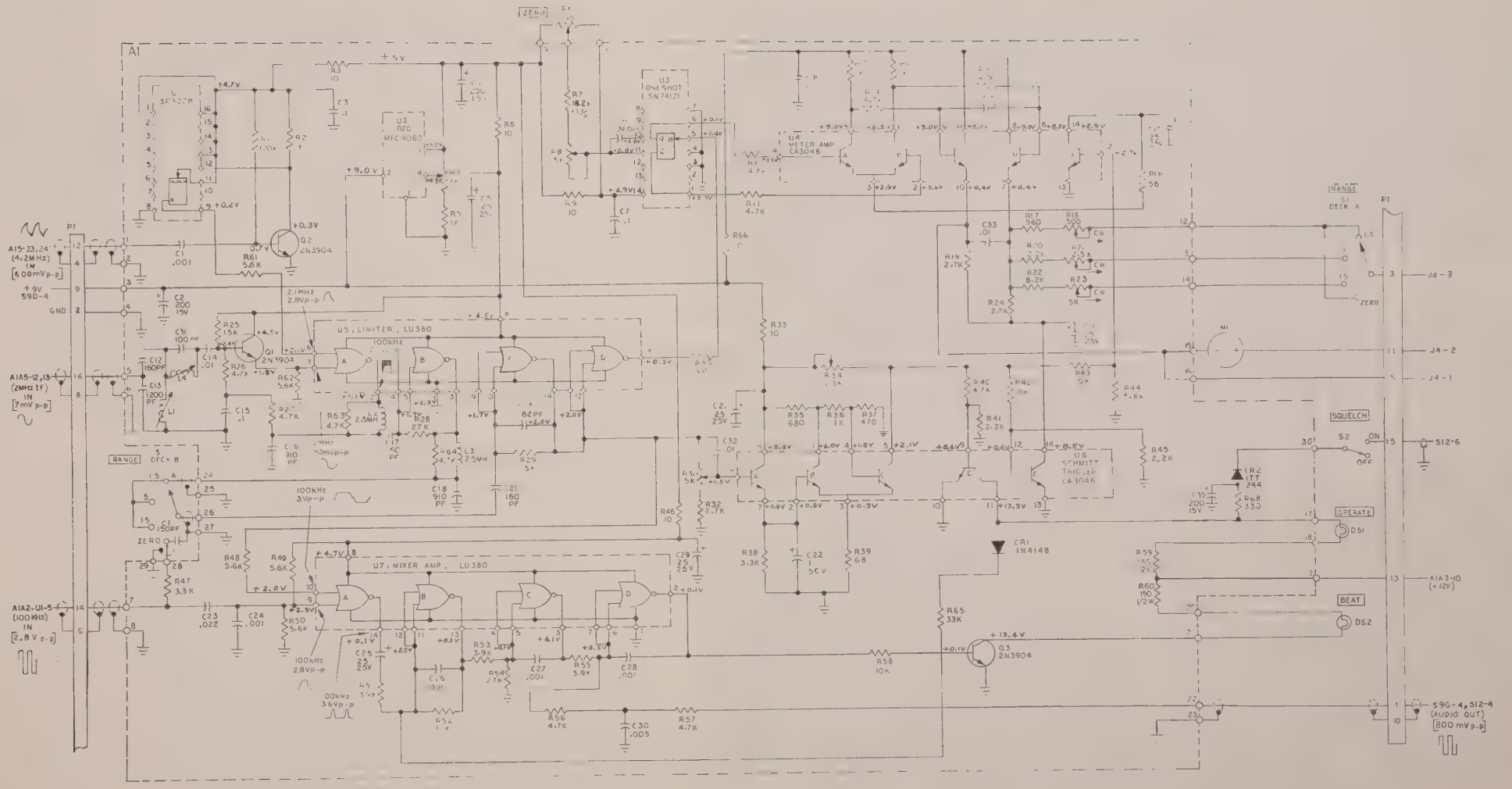
Section IV
SCHEMATIC DIAGRAMS



HIGHEST REF DESIGNATIONS USED						
L4	U7	C33	R66	Q3	CR1	
REF DESIGNATIONS NOT USED						

4. ALL DC VOLTAGES TAKEN WITH NO SIGNAL APPLIED AND FM-100 MODE SWITCH IN THE MEASURE POSITION (DISABLE INTERVAL TIME BASE).
3. VOLTAGES SHOWN WITHOUT TOLERANCE ARE TYPICAL.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.
1. ALL RESISTORS ARE IN OHMS ±10%, 1/4W.

Figure 4-1. Schematic Diagram, Model FIM-1
Dwg. No. 4-501162-001(F)



HIGHEST REF DESIGNATIONS USED							
L4	U7	C35	R68	Q3	CR2	S2	
REF DESIGNATIONS NOT USED							
			R67				

Figure 4-2. Schematic Diagram, Model FIM-3
Dwg. No. 4-501262-001(E)

4. ALL D.C. VOLTAGES TAKEN WITH NO SIGNALS APPLIED AND FM-10C MODE SWITCH IN THE MEASURE POSITION, (DISABLE INTERNAL TIME BASE)
3. VALUES SHOWN WITHOUT TOLERANCES ARE TYPICAL.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.
1. ALL RESISTORS ARE IN OHMS ±10%, 1/4 W.

APPENDIX A

BACKDATING INFORMATION

For Model FIM-1

Serial Numbers 101 thru Serial Numbers Suffixed with 04273

This manual refers directly to serial numbers suffixed with 04274 and above. The following information is provided to adapt this manual for serial numbers 101 thru serial numbers suffixed with 04273. Perform the following changes to the manual down to the effective serial number of your instrument.

Effective serial numbers: 101 thru serial numbers suffixed with 04273

Page 3-6: Table 3-2. Parts List for Printed Circuit Board Assembly, A1 (Cont.)

Change R32 to:

Resistor, fixed, composition, 4.7 kilohm, ±10%, 1/4 W	1-945000-045	01121	CB4721

Page 4-3/4-4: Figure 4-1. Schematic Diagram, Model FIM-1

Change R32 to 4.7 K

APPENDIX B

BACKDATING INFORMATION

For Model FIM-3

Serial Numbers 101 thru 400

This manual refers directly to serial numbers 401 and above. The following information is provided to adapt this manual for serial numbers 101 thru 400. Perform the following changes to the manual down to the effective serial number of your instrument.

Effective serial numbers: 101 thru 400

Page 3-6: Table 3-2. Parts List for Printed Circuit Board Assembly, A1 (Cont.)

Change R32 to:

Resistor, fixed, composition, 4.7 kilohm, ±10%, 1/4 W	1-945000-045	01121	CB4721

Change R34 to:

Resistor, fixed, composition, 470 ohm, ±10%, 1/4 W	1-945000-033	01121	CB4711

Page 4-5/4-6: Figure 4-1. Schematic Diagram, Model FIM-3

Change R32 from 2.7K to 4.7K

Change R34 from 2.5K variable to 470 fixed.